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COVER: Fair daughter of Erin, Judith Woodworth typifies the youth of the Irish Republic, where an improving economy offers new opportunities (page 354).
EXTACHROME BY JAMES A SUGAR NG.S.
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"W
Florida's Manatees,
EDNESDAY the ninth of January
... when the Admiral went to the
River of Gold,* he said he saw three
mermaids they were not as beautiful as
they are painted though they had something
like the human face. He said he had seen
some before off the coast of Guinea.
The year was 1493 and the admiral Christopher Columbus. Less than three months
had gone by since he had first sighted the
New World. What he saw was undoubtedly
the manatee, found in African as well as New

World waters and linked to this day with the
mermaid of legend.
My own introduction to the American mer-
maid was not as glamorous, but equally im-
pressive-to me, at least. As a biology stu-
dent, I had chosen the Florida manatee as the
subject for my doctoral dissertation. From a
punt on the spring-fed headwaters of the
Crystal River, 65 miles north of Tampa, I
saw a pair of dark noses break the surface.
The clear water would be ideal for this, my
first chance to observe manatees from beneath
the surface. I eased myself off the bow and
swam toward them, reassuring myself all the
while that, of course, manatees are harmless.
I passed over gardens of algae, over beds of
wild celery, water milfoil, and spires formed
by the rank growth of emerald waterweeds.
Suddenly I was upon them, or rather, they
were upon me, looming forth some twenty
feet away, spectral gray leviathans, colossi,
ridiculously imposing, looking like something
that had eluded the fancy of Jules Verne.
One was heading directly for me. Scientific
inquiry be hanged! I swallowed my pride,
and rocketed back into the boat.
I was safe, a confessed coward. But how
*Probably the Rio Yaque del Norte, in the present-
day Dominican Republic.
A manatee named Zachary takes the au-
thor on a guided tour of the sea cow's irides-
cent realm. With pencil and waterproof
plastic chart for recording details, Mr. Hart-
man pursues his beneath-the-surface study
of these gentle giants-members of a mam-
malian order called Sirenia because of a
fancied resemblance to the mythical siren,
or mermaid.
EXTACHROME N.G.S.
was I ever to conduct my research if I was
afraid to study my subjects?
That was nearly two years ago. Since then
I have spent many days snorkeling with the
very animals that "chased" me out of the
water that fall morning. I have named them
Hobe and Paralee, and they are but two of a
population of forty to fifty manatees that
BY DANIEL S. HARTMAN Photographs by JAMES A. SUGAR
Mermaids in Peril
return each fall to the warm waters at the
source of the Crystal River.
I have now learned that, far from threaten-

ing me, ten-foot, thousand-pound Paralee approached me that morning out of cautious curiosity-and was undoubtedly more terrified by my eruption from the water than I had been by her approach. Manatees have the dispositions of contented cows-and are about as dangerous.

These large and gentle creatures are almost exclusively confined to the tropics (map, page 347). Florida is one of the few places where they have ventured into a temperate zone. Here the coastal water is sometimes too cold in winter, and they must find warmth where

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they can-in spring waters welling from the warm earth or in the tepid discharge of factory cooling systems. When not resorting to springs for warmth, manatees typically inhabit turbid waters. This makes observation difficult, and the literature is full of irresponsible anecdotes based on surface glimpses.

The choice of Crystal River for my 18-month study came after a careful survey of Florida's coasts. I concluded that there was no better place to observe manatees below the surface than in the limpid "bay" at the river's headwaters. It provided a natural laboratory replete with such manatee amenities as a constant water temperature of 74° F. and abundant food. Thousands of normally marine fish shared the warmth of the freshwater springs (page 347).

There was one drawback: it was too crowded. The main spring, 60 feet deep and with underwater caves to boot, was a popular place for skin-divers, who amused themselves by poking, grabbing, riding, or chasing any manatee that happened across their path. Each day when the divers arrived, the manatees and I would depart for quieter reaches.

Southern Names for Gentle Beasts

An average winter morning would find me snorkeling for three or four hours among my animals. I spent afternoons tracking their movements in a runabout, identifying them, and checking social behavior by peering into the water through a glass-bottomed bucket. Most individuals were recognizable by a

combination of size, shape, and scars. Nearly all had been hit by propellers, and the scar patterns on their backs and tails were unmistakable (following page). Because of their love for warm climes, I gave some of them southern-sounding names: Flora Merry Lee, Pearly Mae, Gallatin, Creola, Lavaliere. Their temperaments varied. Most were wary and would not allow close approach. A few were so tame that, when soliciting a back scratch, they would hamper my work by lolling directly in front of my mask.
Seemingly weightless in the emerald headwaters of Florida's Crystal River, the author snorkels among his manatee friends -to all of whom he has given names. Flirtatious Lavaliere, a favorite, nibbles at his leg. As many as fifty of the lumbering vegetarians journey here each fall, attracted by the steady 74° F. outflow of sparkling underwater springs. Winter over, they migrate elsewhere along Florida's warm-water fringes.
KODACHROME NGS
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One young female, Lavaliere, was a notorious flirt. She was brazenly fond of "kissing" my mask and of chewing on my hands and diving suit. She once took the liberty of cuffing off my mask, albeit inadvertently, and of pulling me under with her flippers.
At play, manatees touch muzzle to muzzle in what can best be described as a kiss (pages 350-51). This behavior is one facet of a whole repertoire of nuzzles, nibbles, nudges, butts, and embraces. The performance as a whole becomes a serene ballet, a slow-motion ritual of lazy posturings and positionings, twistings and turnings. This intimate activity is not necessarily performed in a sexual context, calves participate with adults, as do subadults with other adolescents of the same sex.
This should not be interpreted, however, as meaning that manatees are normally gregarious. Though cold weather forces them to congregate temporarily in the sanctuary of warm water, the sole lasting association is that between a mother and her calf. Otherwise, manatees are most often found alone. Groups, when they form, usually consist

of but two or three individuals. These associations are unstable and ephemeral, lasting from a few minutes to a few hours. If you were to follow Hobe, say, on his daily rounds, you would soon appreciate that he owed allegiance to no one, that he joined a certain friend to feed, swam away with others to rest, cavorted awhile with a reluctant female, but spent most of his time idling, cruising, and exploring by himself.

Seventeen Bulls Escort One Cow

The one exception is the herd composed of a cow in heat doggedly followed by courting bulls. Such a herd may remain together for more than a month. Younger males come and go, but a nucleus of mature bulls is always present to escort the cow wherever she leads them. One day a cow and her train filed past me as if in review. There were 17 escorts in her retinue-nearly the entire male constituency of Crystal River!

Throughout the antic performances of manatees, an alert snorkeler, if he holds his breath, will be treated to a weird serenade of chirp-squeaks, squeals, and screams-manatee talk. These high-pitched sounds are emitted in a perplexing variety of unrelated circumstances. They are apparently not echolocating noises, such as porpoises make, but seem to be associated with emotional states, especially alarm. One predictable vocal reaction is the alarm duet between a mother and

KODACHROMES BY JAMES A SUGAR (ABOVE) AND DANIEL 5. HARTMANN.G.S.

Double insulation: The author ties off the entry chute of his outer suit, donned over a skin-tight inner suit to conserve body heat during a three-hour session of manatee watching. A grant from the National Geographic Society supported his pioneering underwater study of these increasingly rare coastal denizens.

Ugly scars, carved by a speedboat's slashing propeller, pattern the back of a lounging manatee. The animals often loll just beneath the surface, invisible to boatmen, and many bear marks of similar encounters.

Shaded areas show
known range of manatees

F
Tallahassee
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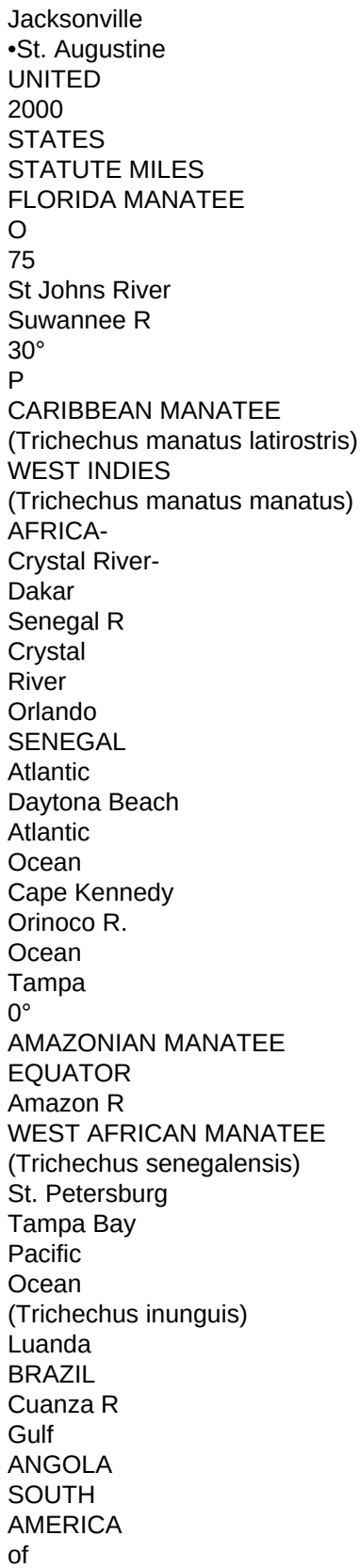
Jacksonville
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UNITED
2000
STATES
STATUTE MILES
FLORIDA MANATEE
O
75
St Johns River
Suwannee R
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P
CARIBBEAN MANATEE
(Trichechus manatus latirostris)
WEST INDIES
(Trichechus manatus manatus)
AFRICA-
Crystal River-
Dakar
Senegal R
Crystal
River
Orlando
SENEGAL
Atlantic
Daytona Beach
Atlantic
Ocean
Cape Kennedy
Orinoco R.
Ocean
Tampa
0°
AMAZONIAN MANATEE
EQUATOR
Amazon R
WEST AFRICAN MANATEE
(Trichechus senegalensis)
St. Petersburg
Tampa Bay
Pacific
Ocean
(Trichechus inunguis)
Luanda
BRAZIL
Cuanza R
Gulf
ANGOLA
SOUTH
AMERICA
of

Mexico
Fort Myers
Rio de Janeiro
3p
Lake
Okeechobee
Making a last stand on both sides of the Atlantic, three species of manatee steadily retreat before man's encroachments. The subspecies Trichechus manatus latirostris-now found only along Florida's coast-once ranged by the thousands from North Carolina to the Texas Gulf Coast.
Known haunts of the manatee in Florida shown in dark green
EVERGLADES
NATIONAL
PARK
100
838
Miami
STATUTE MILES
DRAWN BY ALFRED L ZEBARTH
GEOGRAPHIC ART DIVISION
NATIONAL GEOGRAPHIC SOCIETY
*Key West
Sporting a patchwork coat of algae, a yearling calf named Uggams shares the warmth of a spring with a school of gray snappers. Long hunted for meat, hide, oil, and ivorylike bone, his kind may go the way of Steller's sea cow, a 25-foot, 6,000-pound relative discovered in the Bering Sea in 1741 and hunted out of existence in less than thirty years. Florida law now protects the manatee, but occasional poaching and thoughtless shooting by thrill-seekers persist.
EKTACHROME BY JAMES A SUGAR NATIONAL GEOGRAPHIC SOCIETY
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KODACHROME OT
her calf as she calls it to her side before fleeing. Manatee vision is relatively unspecialized and probably myopic. These animals, after all, have little use for their eyes. In their normal environment of silt-laden rivers and turbid estuaries, visibility may be no more than a foot. Their sense of smell is in all likelihood rudimentary, if not altogether absent; their nostrils are tightly closed by valves while they are submerged and open only during
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the few seconds when they surface to breathe. Voracious feeders, they spend a quarter of the day consuming indiscriminately whatever submerged aquatic plants happen to be at hand. Each day they eat more than a pound

of vegetation for every ten pounds of body weight. They do not, as was formerly held, use their flippers to guide vegetation to their lips. They don't need to. It's enough for a manatee just to evert its horrendous lip pads and tuck the plants into its mouth with the attached bristles.
When they are not feeding, manatees are apt to be resting, either prone on the bottom or hanging suspended near the surface. Periodically they ascend slowly to the surface, as if pulled upward by guardian hands manipulating invisible strings to ensure that their charges don't drown. They stay up approximately four seconds, half devoted to exhaling,
Scratch rig
long Adelai
fully accept
Though us
beast can a
an hour, pr
of her tail.
One of hem
folded skin

[PAGE BREAK]

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34
half to inhaling. They then sink once more with a grace belying their bulk.
Manatees remain submerged longest while resting on the bottom. During my observations the record was set by Immer, a young male who stayed down nearly thirteen minutes. His time was exceptional. The usual submergence interval while resting is closer to five minutes. But an actively swimming manatee needs more oxygen and may surface once a minute.
In waters frequented by these great animals, the informed visitor is alert for the telltale snout proclaiming a surfacing manatee. It's as much as he's likely to see. Yet when frightened a manatee may light out at speeds close to twenty miles an hour, churning the water to a froth.
Many visitors who fish the Crystal River

have never heard of manatees and are understandably dumbfounded when the monsters appear. I have seen stunned fishermen actually drop their rods and scan their minds' eyes for rational explanations-muskrats, beavers, otters, porpoises, whales, even divers. One teen-ager was heard to insist, "Mullet don't grow that big, Pa."

As the Gulf of Mexico cools in October, the Crystal River manatees move upstream, where they remain off and on until March. For the rest of the year the animals are seldom present in the headwaters.

Discovering where they went occupied my summer hours. The Florida Board of Conservation generously provided me, from time to time, with a light plane and a pilot. From

Telltale toenails hint at the manatee's terrestrial origins. Scientists believe that both the manatee and its distant cousin the elephant evolved from a common ancestor, a four-footed herbivore that browsed primordial marshes. The elephant's progenitors remained landbound, but the manatee's forsook the land for a totally aquatic life. Forelegs ultimately flattened into flippers; hind legs disappeared altogether.

Muzzle-to-muzzle "kiss," a manatee custom, may aid the weak-eyed beasts in recognition as well as in signaling affection. Manatees also communicate by chirplike squeaking, especially when alarmed. They rarely fight. Bulls may squabble over a female, but only the loser's ego is injured.

[PAGE BREAK]

the air my quarry was easily spotted, often grazing on the pastures of widgeon grass that thrives in the brackish inshore waters. With an anxious eye out for sharks, I dived into these murky estuaries-and, lo, met familiar animals! I encountered them in rivers as far as twenty miles from "home." I suspect that some go even farther.

To determine the migration routes, I interviewed scores of crabbers, mullet fishermen, and guides. Their replies were colorful, in the idiom of the Florida Cracker. One crusty old crabber complained that the manatees rubbed

on his traps, embedding them in the mud so that he couldn't haul them.

"Takes two things to be a crabber, son. A strong back and a weak mind. Don't yo' never be a crabber. Stick with yore sea cows, bout keep 'em off'n my traps.'

The answer to the puzzle of migration is not complete, but it is definite that manatees migrate offshore, and that they avoid the extremely shallow flats and waterways which snake around the network of coastal islets. Seeking the open water, they travel long-established corridors through the complex of sand bars, oyster reefs, and limestone shelves characteristic of this part of the Gulf Coast

Distant Cousins: Elephant and Manatee

Mermaids-sirenas in Spanish-have been tempting men's imaginations since the time of the most primitive coastal cultures. Columbus's linking of the myth with the manatee is the earliest European reference to the animal in American waters.

One vestige of the mermaid legend has been preserved by science A 19th-century taxonomist, perhaps echoing Columbus, gave the order the scientific name Sirenia. The name manati was probably appropriated by the early explorers from the Caribs of the West Indies, who referred to the creatures as manattoui.

Today it is generally agreed that the sirenians have descended from the same ancestor as the elephants. Evidence for this belief is to be found in fossil specimens which show, among other things, a progressive reduction of the hind limbs. And even present-day manatees have molars that in some respects resemble those of elephants.

There are today only four species of sirenians. Three are manatees; the last is the marine dugong of the Indo-Pacific region. A fifth, Steller's sea cow, existed until relatively recent times. Three tons in weight and twenty-five feet long, it lived in the Bering Sea near Kamchatka. Hunters, killing it for meat, exterminated the species by 1768.

Manatees and dugongs may be going the way of their Bering Sea kin. Throughout their range, they are rare or endangered. Many former manatee haunts in the rivers of West Africa and Central and South Ameri-

ca are now empty. The animals have been hunted and harpooned, manatee steaks are a prized supplement to native diets. Even in Florida, where a poacher risks a $500 fine, manatees are occasionally killed for food or so-called sport.

Manatee's Enemy Must Become a Friend

In the United States manatees were once found as far north as the Carolinas and all the way around the Gulf Coast. Now they survive only in Florida, and there only in isolated pockets. Their comeback is handicapped by a slow reproductive rate: at best, one calf per adult female every three years. They cannot sustain any further depletion.

Yet the encroachments of civilization are being felt. The current Florida boom is preempting wildlife habitats. Pollution has already destroyed the manatee's food resources in several rivers. Waterfront developments temporarily avert catastrophe. They usually entail the dredging of canals which, when colonized by aquatic plants, provide new manatee pastures. But ultimately they mean an increase in human population and more power boats, the scourge of manatees. As soon as the toll taken each year by propellers exceeds the annual production of calves, the manatees in an area are doomed. This could happen soon at Crystal River.

Manatees are harmless. They have no defense but flight, no natural enemies but man. Their future rests entirely in our hands.

Improbable siren: Orville, a 1,200-pound manatee, presents a visage that few close-range observers could confuse with a lovely mermaid Valvelike nostrils, tightly sealed when under water, open wide when the manatee comes up for air. Crusts on the skin may be caused by shuttling between salt water and fresh.

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first time, in favour of Ivan Terence Sanderson, Douglas Stewart Raitt and Richard Holliday Pott.

The President reported the deaths of Dr. Nicholas E. Brown, Associate, and of the Rev. P. G. M. Rhodes, D.D., Fellow, of the Society.

Zoological notes from the voyage of Peter Mundy, 1655-56.

(a) Birds. By Mr. N. B. KINNEAR; (b) Sea Elephant

on St. Helena; Whale at Greenwich. By Mr. F. C. FRASER.

PETER MUNDY was a Cornishman and was born at Penryn about 1596, and, after making several journeys in Europe to various places including Constantinople, he joined the East India Company and sailed for India in 1628, returning in 1634. In the following year > accompanied Sir William Courten's fleet to India and Jap returning in 1638. After a year in England he went to Rusia, Prussia and Poland, and was absent for seven years. Then in 1655 he sailed on his third voyage to India in the Aleppo Merchant and came back in 1656.

Mundy was a very careful observer and made many interesting notes in his journals, frequently illustrating them with sketches *. In the three volumes of his travels, which have already been published by the Hakluyt. Society, various animals are mentioned and some of his sketches are produced, including that of the extinct Rail-the Mauritius henne of Mundy, Aphanopteryx bonesia (vide Journals of Peter Mundy', vol. iii (pt. 11). p. xvii, and Sclater, 'Ibis', 1915, pp. 316-319). The fourth and final volume is being edited by Miss Anstey, who assisted the late Sir Richard Temple with the earlier volumes, and, through the kindness of the president and council of the Hakluyt Society, we are enabled to reproduco some notes and drawings of Mundy's for this volume. On his final return voyage from India in 1656, the ship Mundy was in called at Ascension on 7th June or in June, and he relates how 'Some of our company went up (the Hills) and brought downe ... halfe a dozen of a strange kind of fowle, much bigger than our sterlings ore stares: collour gray or dappled, white and blacke feathers intermixed, cies red like rubies, wings very imperfitt, such as wherewith they cannott raise themselves from the ground. They were taken running in which they are exceeding swift, helping themselves a little with their wings (as it is said of the estridge), shortt billed cloven footed, thatt can neither fly nor swymme. It was more than ordinary dainety meatt, relishing like a roasting pigge..

A completo copy of these journals is in the Bodloan Library, and some parts aro in tho British Muscuin.

PP. 32-37

DRAWINGS BY PETER MUNDY

PL 2

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"I have heretofore asked the question concerning Mauritius henns and dodos, thatt seeing those could neither fly nor swymme, being cloven footed and without wings on an iland far from any other land, and none to be seene elce where,

how they shold come thither? (see vol. ii, p. 318). Soe now againe concerning the Ascension birds allsoe that can neither fly nor swymine. The iland being about 300 leagues from the coast of Guines and 160 leagues from the iland of St. Matheo, the nearest land to it, the question is how they shold be generated, whither created there from the beginning or that the earth produceth them of its owne accord, as mice, serpents, wormes, etts. insects, or whether the nature of the earth and climate have alltred the shape and nature of some foule into this, I leave it to the learned to dispute of.

These remarks, together with Mundy's sketch, make it evident that this bird must have been a Rail which is now extinct. The island of Ascension is of volcanic origin and is more or less a barren cinder desert with the exception of the hills, where there is a certain amount of undergrowth and moisture which would give cover and feeding to a small Rail.

None of the other early voyagers who visited the island mention any indigenous land bird. A flightless Rail would be easily exterminated by the rats which for long have been common on the island, and were possibly first introduced when Dampier was wrecked there in April 1701. In the S. Atlantic Ocean an entirely black small flightless rail still exists on Inaccessible Isle, discovered in 1923 and described by Dr. P. R. Lowe as Atlantisia rogersi. On Tristan da Cunha there was formerly a black Moorhen, Porphyriornis nesiotis, very similar in appearance to the European Moorhen, which became extinét through the introduction of rats about the middle of the last century, and on Gough Island the closely allied P. comeri still exists.

Sea Elephant on St. Helena. By Mr. F. C. FRASER.

ON Mundy's ret n voyage from India in 1656 the Aleppo Merchant called St. Helena, and Mundy went on shore for a walk, he say

'Beeing sett on shore near Chappell Vally, as I went along uppon the beach, I,saw a strange creature (Pl. 2. fig. 2) lying along thereon, and as I drew near, I perceaved it was alive. It was very weako and (as afterward was found) hurtt in divers places. However, when I touched it, raised his forepart, gaping on mee with his wide and terrible jawes. It had the coullor (yellowish) and terrible countenance of a lion, with four greatt teeth, besides smalle, long, bigge smelling hairs or mustaches. Afterwards itt made way towards the sea, when I tooke uppe a good bigge stone (and) with both my

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hands flung it att his head, which slagred him, and then

with more stones made quite an end of him; in length about ten foote and five foote about the middle. Some say it was a scale, others notte. I terme itt a scalionesse, boeing a femall. There wee left itt, beeing near after the forme hereunder the haire very shortt, butt the mouth oxceeding wide, wider then here sett downe, according to proportion of the rest.'

Although it is far to the north of the known distribution of the Southern Elephant Seal, Mirounga leoninu, the drawing and description given by Mundy suggest that the seal he saw belonged to this species rather than any other. These animals, which are now mainly confined to South Georgia, Heard, and Macquarie Islands, have been recorded from Tristan da Cunha and as late as 1926 one was killed on the South African coast. They are very strong swimmers, capablo of covering great distances, and it is just possible that one could have reached St. Helena. The wrinkling of the pro-boscis shown in the drawing, and the description of colour, noticeable canine teeth, and the behaviour of the animal when touched all suggest to me an Elephant Seal.

I would say a young male-not female,-the sex could easily have been mistaken.

Lydekker (P. Z. S. 1899, p. 797) states that no seals are known from St. Helena. His paper deals with The supposed former Existence of a Sirenian on St. Helena', and instances among others a Sea Cow killed in 1739 while it was lying asleep on the brach. The animals were killed for their oil, and a government duty had to be paid on them. Lydekker's objections to the animals being seals are: (a) the name Sca-cow was not to his knowledge popularly misapplied to seals; and (b) too much importance must not be attached to the record of this animal sleeping on the beach, as it is mainly negative evidence, and, on the other hand, might not hold good for a supposed extinct species of Sea-cow which might have behaved in this way.

In favour of the idea that these 'Sea-cows' (were seals must be considered: (a) the fact that one at least did haul out on the beach; (b) the recorded quantities of oil extracted from carcasses suggest the abundance in which it is present in scals; (c) the Mundy record'which is definitely that of a scal. Furthermore, Lydekker secins to have overlooked what Dampier liad to say on the subject when he visited St. Helena in 1691. According to the old records of the St. Helena Government, as quoted by Lydekker, two men were convicted in the previous year for not paying duty on the oil they had obtained from a 'Sca-cow'. Dampier must have known of this, since he says:-

I was also informed that they get Manatee or Sea-Cows hore, which seemed very strange to me. Therefore enquiring

more strictly into the matter. I found that the Santa Hellena Manatee to be, by their shapes and manner of lying ashore on the Rocks, those creatures called Sea-lyons; for the Manatee never came ashore, neither are they found near any rocky shores as this Island is, there being no feeding for them in such places. Besides in this Island there is no River for them to drink at, tho' there is a small Brook runs into the Sea, out of the valley by the Fort.'-' Dampier's Voyages' (Masefield ed.), p. 526.

Whale at Greenwich. By Mr. F. C. FRASER.

Mundy, in his diary, gives a very full description of the whale stranded at Greenwich, the occurrence of which is already well-known from the account given by John Evelyn in his Diary. Mundy's description is as follows:-

Pp. 96-8.-3 June 1658. A whale (Pl. 2. fig. 3) came in the river of Thames, betweene Blackwali and Greenwyche, where it was killed by the watermen. The like hath nott hapned in no mans daies now living, nor to he found on record. It was 58 foote long, measured 12 foot high (Evelyn says 10 ft.) and 14 broad. Shee had very smalle eyes which lay very near the ground, one becing on both sides of the heal, shee lying on her belly (for they say it was a female) a deformed head, different in shape from thatt of other fishes, as is the head of an elephantt from those of other foure footed beasts, but their bodies somwhat alike. Shee had two holes in the upper part of her head, out of which shee spouteth wind and, water, which I have often scene at sea. In one of the said foles or nosthrills they had flung in a small anchor. The fynnes or whales bone grow in the upper jaw, which falleth in and is inclosed by the neither. It seemes to be a yong one by the smallness and shortnesse of the said fynnes, by comutation not above 4 or 5 foote in length (whereas I was formed there are of 10 foote long and 10 inches broad at the te and soc lessning), growing downeward from the upper jaw, enclosed by the neither as abovesaid, close placed ono by another edgewise, the thicker edge outward, the thinner withinside, all hairy. Soc that I conccave a very small fish or worme can hardly gett forth, becing enclosed, yet may the water straine through, somwhatt after the forme following, as I saw it the first tyme the 4th June.'

Mundy's explanations of his drawings of the Whale are as follows:-

'No. 1. Att a is her upper jaw with the finnes or gilles fastned therin, with their points growing downeward, falling into the under jaw and enclosed therin. [See Pl. 2.]

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the first positive group (B'II AE) in which
nccording to Kaplan the predissociation should occur.
In this investigation, the work done by Naudé' on
the 5-2 and 6-3 transitions of the same band
system was of great value. Naudé has pointed out
timt the structure of the first positive group agrees
with a transition. Twenty-seven branches
are to be expected, nine strong branches and eighteen
weaker branches. If the B³II state were in Hund's
case, only the nine strong branches should occur.
But the B'II state is in case a for the lower J values
and proceeds to case b for higher J values. A rota.
tional analysis of the 12-8 band showed that the
band lines suddenly become much less intense.
This happens at J = 32 for the II, level, J = 33
for 1, and J = 34 for ³II, and in the R and P
branches at the same place as in the Q branches.
This cannot be explained by assuming that the
state causing this predissociation is S+S. This
level gives rise only to Σ-states. -states are in
Hund's coupling case b. For such high rotational
levels we are certainly also for the II-states nearly
in ense b. Each one of the three E-states forming a

triplet perturbs only one of the II-triplet states. These II-triplets are double because of the 1-doubling 2-states are not. Therefore only one of these A-doubling components of the II-states should predissociate, whereas on the contrary I observed the predissociation in both the A-doubling components (P. and R. as well as Q-branches prelissociate). We thus may conclude that the perturbmg level in this case is certainly not SS but that it may be S + D, as was formerly assumed.

A. VAN DER ZIEL.
Natuurkundig Laboratorium
der Rijks-Universiteit,
Groningen.
Jan. 10.

'hus ir 37, 1400; 10:31. 38. 1079; 1931. 41. 114 10.32.
Eresh, raukt. Naturicies., 10, 207; 1931.
2. PS4, 304; 1933.
Pre Roy. Soc. A., 136, 114: 1932.

417

Dampier gives (I, p. 64-67) an excellent description of the manatees and their mode of life from his own observations in the West Indies, the Philippines and Australia. Thus he knows what he is speaking about. His direct statement concords with the result reached indirectly through my own observations. The evidence is accordingly now conclusive that the much discussed St. Helena 'manatee' is a sen-lion, and the conclusions in regard to former land connexions drawn from the existence of the 'manatee' at St. Helena are without foundation.

Zoological Museum.
Copenhagen.
Feb. 18.
TH. MORTENSEN.
Vidensk. Medd. Dansk Naturhist. Forening., 97; 1933.

If

Possibility of Incomplete Sex Linkage in Mammals

In a paper shortly to be published, Koller and Darlington find that, in the first meiotic division of Rattus norvegicus males. one or two chiasmata are formed between the X and Y-chromosomes. chiasma formation corresponds with the crossing-over of genes, it follows that where the chiasma lies between the locus of a gene and the region in which X and Y-chromosomes differ, such a geno will exhibit crossing-over with sex. On the basis of the cytological observations, genes in a certain region of the chromosome should show about 5 per cent crossing-over with sex, in another about 45 per cent. These latter genes would behave in very nearly the same manner as autosomal genes. It thus follows

that some genes regarded as autosomal may in reality be incompletely sex-linked. Such linkage would show up in a pedigree of the following type:

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The 'Manatee' of St. Helena

IN my paper "On the Manatee' of St. Helena" I brought forward evidence that the so-called manatee formerly found at St. Helena was a sea-lion, probably the Cape sen-lion, Arctocephalus antarcticus, not a sea-cow, natural conditions at St. Helena being quite unsuitable for sea-cows. Sir Charles Harper, formerly Governor of St. Helena, to whom I sent a copy of my paper, has very kindly directed my attention to a passage in Dampier's "Voyages" (ed. by Masefield, publ. by Grant Richards, London, 1906), which has a very important bearing on this question.

Dampier, who visited St. Helena in June 1691, also mentions the 'manatee'. stating: "I was also informed that they get Manatee or Sea Cows here, which seemed very strange to me. Therefore inquiring more strictly into the matter. I found the Santa Hellena Manatee to be, by their shapes, and manner of lying ashore on the Rocks, those Creatures called Sea-lyons; for the Manatee never come ashore, neither are they found near any rocky Shores, as this Island is, there being no feeding for them in such places. Besides, in this Island there iso River for them to drink at, tho' there is a sta! Brook runs into the Sea, out of the Valley by The Fort" (I, p. 526).

The progeny in the third generation would be in the proportions

55 Aa: 45 aa : 45 Aa : 55 aa

A

in a case involving 45 per cent crossing-over. glance through the literature shows that data must be available which would enable this hypothesis to be tested, but that they have not been published since the progeny of such matings are not usually classi-

fied for sex.
We wish to appeal to authors to give data in future communications which will enable the above hypothesis to be tested, and, where possible, to examine for partial sex-linkage the data on which former publications have been based. It is most likely that such cases would be found in mammals. including man, where the Y-chromosome is often fairly large as compared with the X-chromosomes. but they are perhaps also possible, mutatis mutandis. in birds and other groups.

C. D. DARLINGTON.
J. B. S. HALDANE.
P. CH. KOLLER.
John Innes Horticultural Institution,
London, S.W.19. Feb. 28.

Strictement réservé à l'usage p.
(Loi n° 57298 du 11.3.57, art. 41,2º)

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to use this for further estimations of the individual
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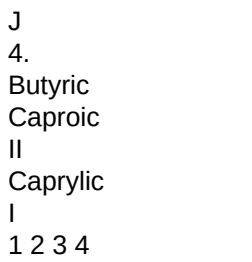
The study of the rate of recovery of various volatile acids, added in known quantities to the cheese mush, led to doubt as to whether this method of distillation uite in the complete extraction of the volatile als (specially the higher members of the series) from the cheese. It appeared that the higher acids were to some extent hold back by the constituents of the cheese, and did not therefore distil over at the rate suggested by Dyer's figures'.

This view was strengthened by a series of experiments in which several acids were distilled from water, and a mixture of fresh, washed butter fat and water. It was ovident that there was retention of

some of these acids by the butter fat, very marked for lauric acid and high for caprylic, but decreasing through caproic to butyric and the lower members of the series, in which no retention was demonstrated.



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The Stock of Antarctic Blue Whales

DURING the current investigations into the conditions of Southern whaling, I have had occasion to consult the publications' of the Norwegian Whaling Bureau, in which the catch statistics given in "International Whaling Statistics" have been amplified and to some extent analysed. From these data I have calculated the average length of female Blue whales taken from 1930 to 1935. The results are shown in the following table.

Season	No. of whales considered	Average length (ft.)
1930-31	4,532	82.30
1931-32	close season	
1032-33	5,285	81.97
1933-34	6,487	81.85
1934-35	7,253	70-88

A slight annual decrease in length up to 1933-34 is followed by a sharp drop of nearly two feet in 1934-35. Blue females become sexually mature at about 78 ft., when they are approximately two years old. They arrive at maturity in the southern winter, and are found in the Antarctic the following summer with an average length of 80 ft. Pairing in July

may result in pregnancy which
lasts for ten months.
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FIG. 1. Fatty acid recovery by steam distillation: I, acld distilled from distilled water; 11, acid distilled from pure butter fat; III, distillation figure given by Dyer.

It was found, however, that although the rate of istillation of the higher acids was retarded by the presence of butter fat, almost complete recovery could be effected if the steam distillations were continued for a sufficiently long period. For the acids up to and including caprylic, more than 90 per cent of the added acid could be recovered by collecting a distillate of three times the original volume. For lauric acid, on the other hand, only 50 per cent was recovered even after collecting six times the original volumo (cf. Fig. 1).

If the rate of distillation of these acids from a hese mush is comparable with that from a mixture of butter fat and water, then the practice of collecting a distillate of three times the original volume would allow an estimate of the distribution of volatile acids in cheese which would be sufficiently accurate for many purposes. It is suspected, however, that a still greater retention occurs in the cheese mush, and the influence of cheese fat (as distinct from itter fat) and the protein and salt mixtures of cheese is being examined in an effort to elucidate this question.

E. R. HISCOX.
J. HARRISON.
National Institute for Research in Dairying,
Shinfield, Nr. Reading, Berks.
May 25.

D. C. Dyer, J. Biol. Chem., 28, 445 (1910-17).

Blue females taken in 1934-35 were, therefore, on the average, killed at the outset of their reproductive career. The consequences of continued intensive killing need scarcely be emphasized.

Average lengths were shown in the Norwegian publications, but the data had been divided, and average lengths were given for immature and adult whales separately. The constancy of the averages from season to season was invoked as evidence that undue depletion of the stock is not yet taking place,

but since no account was taken of the rapidly mounting percentage of immature whales in the catch the results are liable to be misleading.

"Discovery" Investigations,
52 Queen Anne's Chambers,
London, S.W.1.
June 3.

ALEC H. LAURIE,

Hjort, Lie and Ruud, "Hvalrådets Skrifter", 3, 8, 9, 12.
Mackintosh and Wheeler, "Discovery Reports", I, pp. 468-9 (1920).

The Manatee of St. Helena

IN NATURE of March 17, 1934, p. 417, Prof. T. Mortensen quotes Dampier's reasons for refusing to believe in the existence of the sea-cow in St. Helena. The bibliography on the subject appears to be far from complete; but fortunately records by two eye-witnesses are available.

Probably the best account of the St. Helena manatee will be found in Barnes's "Tour of St. Helena" (Richardson, London, 1817, pp. 116 and 117). where a detailed description of the animal is quoted from the manuscript of Lieut. Thomas Leech, "written many years ago". The Leechs were a well-known and highly respectable Island family, and Thomas

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(Loi n° 57298 du 11.3.57, art. 41,2º)

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Leech, who affirmed that the sea-cow was really a sea lion, is mentioned in Brooke's "History of St. Helena" (1824 ed., p. 51), as one "who by his unwearied pursuits in historical research, and his surprisingly retentive memory had acquired a great degree of general information".

There is another very important reference in Dr. Walter Henry's "Events of a Military Life" (2nd ed., Pickering, London, 1843, vol. 2, pp. 66 and 67), which is as follows:

"We had sea-cows at St. Helena, the Trichechus Dugong, but they were not common. When shooting near Buttermilk Point with another officer one calm evening, we stumbled on one lying on a low rock close to the water's edge, and a hideous ugly brute it was, shaped like a large calf, with bright green eyes as big as saucers. We only caught a glimpse of it for a few seconds, for as soon as it noticed us, it jumped into the sea, in the most awkward and sprawling manner.

Dr. Henry, whose book is well known to Napoleonic students, was an alert and accurate observer of current events, who later reached high rank in the Army Medical Service and died in 1860. His observations were made between 1817 and 1821; probably in 1819.

It may be a convenience to students if I recapitulate the references to be found to sea-cows in the Public Records of Jamestown:

1679, January 27.
1682, August 29.
1600, March 20.
1091, May 11
(a month before
Dampler's visit).
1716, August 29.
1730, September 11.
First use of the name Manatee Bay.
Several sea-cows caught.
A very small sen-cow killed.
Sea-cow on shore to Windward.
400 lb. ambergris found in Manatee
Bay.
A sea-cow killed.

Burnham's sea-cow of 1810 referred to by Lydekker and Mortensen, I am unable to trace as recorded in the Public Records; but the latter quotes Janisch's confirmation of it to be found in "Scraps from Records" (Government Printer, Jamestown, 1880, to accompany the St. Helena Almanack of that year).

G. C. KITCHING.
The Castle,
St. Helena.
April 18.

A Case of 50 per cent Crossing-over in the Male Drosophila

WITH the view of synthesising a double recessive black-vestigial stock of Drosophila melanogaster, Dr. G. Eloff made a cross of black and vestigial, both of which are contained in the second chromosome. The F. generation, to his surprise, contained many b vg flies. To solve the question, the F, males were mated with double recessive females (b vg), when an independent segregation of black and vestigial was found. He applied the fact to the F, data to calculate the crossing-over value between b and vg in the female, and estimated it to be 17.8 per cent. The value is close to the standard value of 17.0 per cent (18.5 per cent, according to the recent census). For his 50 per cent crossing-over in the male, he writes: "Some other explanation (for example, of chromosomal mutation) must be offered".

In my opinion, Dr. Eloff used by mistake the other mutant, ebony for example, that appears in another chromosomo. If so, the black body colour should be inherited independently with vestigial, and it would be quite the natural thing that there should

be a 50 per cent crossing-over in the male. According to my understanding, his F, data seem to be nothing but the result of an independent segregation, although deviation was considerable.

Furitsu Koto-Gakko,
Biological Institute,
Meguro, Tokyo.
March 6.

G. Eloff, NATURE, 137, 151 (1930).

DAIGORO MORIWAKI.

SINCE the appearance of my letter in NATURE of January 25, Prof. Tammes of Groningen has written to me as follows: "Gottschowski (of Berlin-Dahlem) is of opinion that the 'black' which you used was probably not the normal black but the so-called 'black Kreidel Holland' which is the same as sooty

The stock which I received from Groningen was only labelled 'black'. But it probably was a 'sooty' culture from stocks used by Dr. van Herwerden (and her student Kreidel), who got their cultures from America and Berlin-Dahlem. For some reason which is not clear to me at present, this 'sooty' stock was either labelled "black Kreidel Holland" or "black". In order to make sure that it was the 'black' culture which was responsible for the independent segregation obtained, I this time made use of a vestigial stock from Berlin-Dahlem. The class representations of two series of repulsion back-crosses, the F, of which I have just finished counting, were as follows:

F■o back-crosses: 204 BV, 235 6V, 194 Bv, 171 bv
BV+bv
BVbV+ By + bu
approx. 46.6 per cent.

F■ back-crosses: 701 BV, 839 6V, 670 Bv, 698 bv
BV + bv
BV+bV+ Bu + bu
approx. 48.1 per cent.

As the data refer to repulsion crosses only, the unequal representation of the classes may be explained by (1) difficult separation of bV and BV phenotypes in some experiments, with the result that BV phenotypes may be included in class bv; (2) poorer viability of classes homozygous for vestigial, namely, Bv and bv. Making allowance for these

disturbing factors, it is quite possible that the correct percentage will be 50.

I am satisfied, therefore, that the stock I have used and which was labelled "black" may have been "sooty", so that the results must of necessity show independent segregation.

I regret the misleading results arrived at due to erroneous labelling of the stock, and I wish to thank Mr. Moriwaki for his comment.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.

April 22.

G. ELOFF.

Suggested Cases for Suspension of Rules of Nomenclature

ATTENTION of the zoological profession is invited to the fact that request for the "Suspension of the Rules" has been made in the following cases, on the ground that "the strict application of the Règles will clearly result in greater confusion than uniformity".

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Protecting the Gentle "Mermaids"

by Eugene Rodgers

The big, gentle American animals called manatees were first spotted on his historic voyages by Christopher Columbus, who described them as "mermaids." Their protection is now factored into the technology that supports the voyages of the space shuttle.

The strange, lumbering mammals look something like walruses, swim like dolphins, eat grass, and are commonly called sea cows. Only about 1,000 of the Florida variety are left in the state's rivers, inland waterways, and coastal waters, which they help to keep free of aquatic vegetation. They are protected by the Endangered Species Act and other laws but are sometimes killed or maimed by the whirling propellers of power boats. Most of the manatees in some areas carry propeller scars.

The ships UTC Liberty and

UTC Freedom ply Florida's waters when they retrieve the shuttle's jettisoned solid rocket boosters and tow them back to Cape Canaveral. Operated by United Technologies' United Space Boosters, Inc. subsidiary, they are equipped with special propulsion systems to maneuver close-in to the booster casings at sea and to protect manatees when the ships cruise through the mammals' habitat in Florida's inland waterways. The systems have no external propellers. Thrusters in the bow and stern propel and steer each ship through manatee territory by means of a jet of water that shoots out the bottom along the underside. They're mainly used for precise back-and-forth or broadside-on movements. Thrusters are steered with an aircraft-type joystick, which points the water-jet in any direction by working a grid of slats at the outlet that deflects the flow.

Made by the Elliott Company, a unit of United Technologies, they have been installed on vessels around the world for tasks that call for maneuvering at close quarters or operating on special projects such as diving, drilling, or laying cable. The diesel-powered thrusters on the Liberty and Freedom can produce 425 horsepower and permit a sustained speed of 4.5 knots.

Manatees grow to a length of 15 feet and a weight of 1,500 pounds. They live singly or in family groups, often communicating muzzle-to-muzzle because of poor sight and hearing. Scientists say they are affectionate and playful and have been seen to kiss and swim about with linked flippers.

They are said to be solicitous parents, with bulls and cows taking turns caring for the young. Observers speculate they may have looked like mermaids to Columbus because of the very human way the female holds a nursing calf to her breast. In fact, "manatee" comes from a Spanish word meaning breast. The timid creatures once flourished throughout U.S. tropical waters but have been hunted nearly to extinction for their beef-like meat, fat that makes good cooking oil, and tough hides. One problem for the survival of the species is that reproduction is slow - females have a 13-month gestation period and give birth to only a single calf. Related to dugongs of Africa and the Pacific, the animal is known to science as Trichestus manatus. It belongs to the order of animals called Sirenia, from the Greek word meaning "beautiful maidens." ■

From a United Technologies magazine sometime after 1980

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Shirtsleeve School

by Claudia Chamberlain

When it begins the 1981-82 academic year this fall, the Hartford Graduate Center will round out its 25th year of providing specialized education of professional people. Offering master's degrees only in three disciplines engineering, computer sciences, and management it caters to men and women with college degrees who work full time and spend weekday evenings and Saturdays learning new theory and advanced skills which they can take back to their jobs.

"The Hartford Graduate Center does not seek to be all things to all people. It's a shirtsleeves institution," says Dr. Homer D. Babbidge, Jr., president of the center which stands among 16 acres on the fringe of downtown Hartford, Connecticut.

The idea for the center came one summer's night in 1954 at the Weekapaug Beach, Rhode Island, home of H. M. "Jack" Horner, president and chief executive officer of United Technologies, then known as United Aircraft. At the time, the corporation's Pratt & Whitney Aircraft division was working on the J57, the first jet engine of its own design.

Horner had a problem, he told his guest and summertime neighbor, Dr. Livingston Houston, president of Rensselaer Polytechnic Institute. "Jack Horner needed young engi-
Dr. Babbidge recalls,
neers,
"but he knew that, to attract the talent to Connecticut, his company had to offer them
"1
the opportunity of continuing professional growth through graduate education.

"What he wanted for these young professionals was an academically superior program of graduate study in engineering and related fields. And he was looking for a reputable institution that could break out of long-fixed patterns of convention and deliver the kind of education needed by both students and employers, and on terms suitable to working professionals."

The following year RPI opened a graduate center in what was formerly a farm implement store in nearby South Windsor.

United Technologies had purchased the property, renovated it for academic use, and deeded it outright to the school. The first faculty was made up of seven professors from RPI'S campus in Troy, New York.
Through the years the Hartford Graduate Center has changed and grown. Enrollment in this past spring's semester reached 1,802, an all-time high. The faculty now numbers 20 full-timers, augmented by a roster of some 75 adjunct professors. Specializing still, the center nevertheless has broadened its curriculum beyond the major engineering disciplines to include management and administrative science-again in response to the needs of working professionals and their companies.
In the center's early years, the students were predominantly from United Technologies and its Connecticut units. No longer. Three-quarters of those enrolled last spring worked for more than 800 other companies and institutions, ranging from Etna Life & Casualty to Xerox, from the Urban League of Greater Hartford to Yale University.
United Technologies has remained a strong supporter and user of the graduate center over the years. In addition to giving the center its start, the corporation has made gifts and grants totaling more than $2 million.
Of the 3,000 who have received master's degrees from the center, more than one-third have been employees.
For the past decade, the company has been sending 30 of its middle managers from throughout the country to each of the two-week management pro-

grams the center conducts three times a year especially for UTC. To handle the rising enrollment for master's degrees and a variety of noncredit courses, the Hartford Graduate Center in 1971 moved into new quarters, the $7-million, eight-story complex in Hartford. This year saw the center open branches in Groton and Danbury, Connecticut. Classroom facilities at the main facility are being expanded this summer. And the graduate center is crossing the Atlantic during the next school year to provide educational services to Connecticut-based companies operating in England. ■

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UP FRONT

Of all mammals, the manatee may have the smallest brain in proportion to its body, but that brain is surprisingly complex.

THE MIND OF A MANATEE

While a manatee's barrel-shaped body can easily reach 3,000 pounds, its brain rarely tips the scale at even one pound-a third the weight of the human brain. Traditional biological thinking assumes that such a large animal should have a corresponding large brain, unless it's spectacularly unintelligent. Thus, the manatee's relatively tiny brain led to the suspicion that the animals are cretins. It now turns out that this marine mammal has gotten an extremely bad rap. Biologist Roger Reep of the University of Florida recently completed the first serious study of manatee brains (taken from animals found dead along the Florida coast). Each brain was cut into fine slices, showing the organ's interior regions in cross section. Photo-

graphs of the slices were then digitized and fed into a computer, which calculated the volume of each brain region, including the cortex, where higher men-

tal functions take place.
The results came as a shock. "We thought the manatee's tiny brain might be the result of a cortex that had become disproportionally small and simple," explains Reep. But the proportions of a manatee's cortex turned out to be on par with a primate's. About 64 percent of a manatee brain consists of cortex, compared with 69 percent of, say, a New World monkey brain. Moreover, as in a primate brain, the manatee cortex was intricate, with nerve cells arranged in densely packed layers.
"Clearly there's an apparent contradiction here between small brain size and complex structure," says Reep. But he thinks the paradox can be resolved by looking at the manatee's unusual evolution. The manatee descended from an early plant-eating land mammal that had a relatively small body and brain. When it entered the ocean, however, its diet and habitat created a unique dilemma. It's much harder to stay warm in water than in air, so marine mammals have to generate more heat. But the water hyacinths and other plants that manatees eat are poor sources of energy. As a result, Reep says, manatees were under pressure to evolve bigger bodies. To keep warm, they had to digest vast quantities of vegetation, which necessitated a huge gut. Their brains, meanwhile, were under no such pressure to grow. "Scientists," concludes Reep, "have been looking at this from the wrong end. It's not that manatees are small-brained, it's just that they're big-bodied.'
PHOTOGRAPH BY W GREGORY BROWN ANIMALS ANIMALS

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A
FLORIDA FISHERMAN sits lazily on a bank overlooking the quiet backwater where he hopes to catch his dinner. The late afternoon sun has lulled him nearly to sleep, and it takes all his will power to keep his attention on his motionless line.

Suddenly, he is startled out of his lethargy as he notices a 10-foot brown monster rise silently from the depths, stare myopically at him and, after exhaling explosively, sink back quietly out of sight. Belatedly, the man realizes that the creature was not some man-eating beast. Rather, he has observed the Florida manatee. a rare and harmless animal.

The Truth about the Manatee

Little factual information is known about the Florida manatee. Trichechus manatus, although misconceptions about it abound. In fact, the manatee has been the subject of misnomers, legends, and gross exaggeration ever since the early American explorers named the animals "mermaids" (see "Science and the Mermaid," Sea Frontiers, Vol. 5, No. 2, March-April, 1959). Contrary to popular belief, the manatee is not a fish. It is an aquatic mammal and posses-
ses all the typical air-breathing mammalian characteristics such as hair. mammary glands, warm blood, and a four-chambered heart.

10 feet 3 meters

It is easy to understand how such an animal could inspire some of the tales that are believed by many people. An adult manatee can measure over 12 feet in length and weigh more than 1/2 ton. The head and body are massive, and yet this huge animal is rarely seen as it glides silently beneath the surface in the coastal waters of Florida. The only signs that an observer usually has that a manatee is nearby are prolonged streams of bubbles, the sound of an exhalation, the sudden flight of a coot, Fulica americana, or the sight of an indistinct moving shape underwater.

The manatee is not a lovely animal when viewed from land. Its body is covered by sparse, coarse white hairs and, occasionally, by barnacles or algae. It seems clumsy, slow, and

ungainly. Underwater, however, it performs graceful turns and rolls in an unexpected ballet. Several manatees together may often "play" such games as follow the leader, silently surfacing and submerging, twisting and turning. Amazingly, these seemingly sluggish animals can swim at speeds of almost 25 knots for short bursts, using powerful strokes of their flattened tails for propulsion.

The most common supposition about manatees is that they are stupid, nearly inanimate slugs, an idea derived, no doubt, from the fact that they spend a great deal of their time resting or feeding in one area with relatively little movement. Being herbivores, there is no need for them to develop elaborate prey-catching behavior. They inhabit warm waters

12 feet 37 meters

of rather constant temperature, thus eliminating the necessity for constructing nests or shelters for protection from the environment. Lacking natural enemies, except man, they show no special modes of defense or escape other than simple flight.

Displays of Intelligence

arcul observer will note, how- manatees do show more and determination than which they are usually eded. There are indications that They are innovative, curious, and even intelligent. Often, two manatees that had no way to see one another have suddenly and simultaneously swum together. The obvious sensory modality used to accomplish this is through auditory stimuli and, indeed, hydrophone studies have revealed that the manatee's high-pitched whistles and trills are between 600 and 5,000 cycles per second, clearly audible to the human ear.

An amazing example of manatee communication occurred one day as three adults rested in a tidepool near a quick-flowing flume. Casually, one animal swam to the flume and body

surfed in the current for 30 to 40 feet. This animal quickly submerged at the end of the ride, only to reappear and repeat the performance several more times. After this rare exhibition of apparent play behavior, the manatee did something even more amazing.

The surfing manatee swam to its two companions and, shortly thereafter, all three swam abreast toward the flume. They paused, then suddenly turned into the current and rode it abreast, their heads nearly out of the water. The ride over, the three rubbed noses and nuzzled one another before returning to the flume for another ride.

30 to 40 feet = 9 to 12 meters

The three animals continued to body surf, often with surprising variations, for well over an hour. Almost every ride was followed by nuzzling and mouthing. This event would seem to show that several manatees can indeed communicate and even function as a unit, presumably an indication of some intelligence. Further, social play behavior is usually taken by scientists to be a mark of a rather intelligent species.

An Unpredictable Routine

There are other indications that manatees are fairly intelligent. The animals show an astounding ability to maneuver their huge bodies through small openings such as gaps between pilings on a dam. This suggests another characteristic of manatees: curiosity. Often they will put forth considerable effort to get through an opening to an area they cannot see, only to return soon thereafter to the original spot. Manatee curiosity is sometimes apparent to shallow-water divers who are shocked to find one nuzzling their legs.

Manatees have no apparent pattern of daily activities, although they appear to prefer certain localities within their range for particular ones such as feeding or resting. This

ability to choose areas and change their daily behavior patterns points to an awareness on their part that is unsuspected.

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ALWAYS HUNGRY, Juvenile manatees may still attempt to nurse even though the female is not lactating and the youngster no longer requires milk. Shown above is an 8-foot male trying to nurse with a 10-foot female.

ALTHOUGH OFTEN SIGHTED alone, manatees do show some degree of sociality. They may surface and rest together, breathing and moving in unison (top left). Also, the seemingly ponderous animals frequently play, thereby displaying their amazing grace and agility underwater (lower).

All photographs by the author, except left below C P Migliaccio

There are numerous other myths about manatees, but a few will suffice to show how generally they are misunderstood. A common legend that has embittered some South Florida fishermen is that manatees are carnivores that consume all the fish in an area. This belief is false, as manatees are strictly herbivorous. The only meat that they might consume would be small organisms such as snails that are attached to and ingested incidentally with the plants they eat.

Other Myths

An extension of the meat-eating idea is the misconception that manatees do not eat aquatic plants. Some people believe instead that they chew off grasses and take them to deep water to build nests for their young. It is ecologically unsound for a species to squander energy, and it would take a considerable expenditure of such energy to build a nest for a calf that does not require shelter and that

would probably never use a nest in its nomadic life. Hence, as nobody has ever seen a manatee make a nest or do anything with plants except consume them, this idea, too, must be dismissed as false.

A final common falsehood concerning manatees is that they are capable of biting people and, in fact. will come ashore to do so. This fear

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is understandable from the standpoint that people often fear the unknown, especially if that unknown is large and ugly. If one thoughtfully considers the idea of manatees biting people, he will realize how unlikely it is. First, the manatee's molariform dentition is such that 1 could not break a person's skis. feeds by using its fleshy lips 1 vascular plants and algae inte mouth where the food is ches much as a cow chews its cud. T thought of a manatee coming users to bite someone is even more 12: fetched. They do. indeed. come ashore occasionally to feed on emergent vegetation, but this hauling-out process is laborious and time consuming as the animal pulls its huge bulk out of the water using mainly its tiny pectoral flippers. It would be an extremely slow person who could be caught on land by a manatee.

It is obvious that these animals are, as yet, poorly understood. Lamentably, they are hurt by this lack of understanding. The major causes of manatee deaths in South Florida, whether intentional or not, are all related to man: gunshot wounds, massive infections from ropes tied tightly around the pectoral flippers, crushed vertebrae from being trapped in flood gates and, especially. propeller wounds. Since the Florida manatee is an endangered species of

which probably less than 2,000 members still exist, the effect of allowing such mistreatment to continue must be seriously considered.

There are cures for the present relationship between manatees and man. Foremost is education. Scientific studies are being conducted by the University of Miami and University of Florida to better understand the basic biology of T. manatus. This should help conservationists to establish efficient management programs. Hopefully, these efforts will also lead to better education of the so that people will realize addition to being unique and ing animals, manatees are po- y useful to man as weed in congested canals and as estial source of meat (see "Sea ows Could be Useful," Sea Frontiers, Vol. 12, No. 4. July-August. 1966).

Legal Protection

Two legislative acts now provide some protection for manatees: the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. The former states that manatees may not be killed or molested within United States waters and that a permit from the Secretary of the Interior is necessary to capture them for display or research. Violators may be fined as much as $20,000 and be imprisoned for up to a year. In addition, the Endangered Species Act of 1973 officially categorizes T. manatus as an endangered species and places a ban on the use of any anatomical parts from dead manatees and requires a permit to handle either living or dead manatees. Needed, however, are more awareness and better enforcement of these acts. This, combined with a greater understanding and consideration of manatees, will ensure their existence for some time to come.

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number of manatee deaths. Although scientists are not yet sure exactly how manatees die from the cold, it is clear that they do.

There is a vast amount of biology available from dead specimens," Odell explains. Information on the digestive tract and stomach contents is available from carcasses. Working with the state's Veterinary School in Gainesville, Odell Identified several new species of parasites in the manatee carcasses. And recent work may have uncovered a rare natural threat to manatees: several animals who died near Ft. Myers had a number of tunicates in their digestive system. Tunicates are small, marine animals that live on various forms of sea grass. Manatees probably therefore eat a lot of tunicates while munching their 100-pounds-a-day of sea plants. However, these tunicates had absorbed a great deal of toxin from a recent red tide in the area-too much toxin for the unfortunate manatees.

Physical cataloging is another very important job. Odell has found a maximum size of 389 centimeters (over 12½ feet) and a top weight of more than 1,000 kilograms (2,205 pounds). Odell estimated that individual's age at about 50 years.

Florida's West Indian manatee has a few relatives around the globe. All belong to a group known as Sirena for the mythological half-woman/half-fish. Although it seems unlikely to anyone viewing a manatee close-up, they apparently are the source of the mermaid legends of many cultures. Even Columbus, after a long time at sea, seems to have mistaken a group of manatees for frolicking mermaids. He wrote: "On the coast of Hispaniola I saw three sirens, but they were not nearly as beautiful as old Horace's."

Sirena may look a bit like whales and seals but their evolution was very dif-

ferent. They actually descended from an Upper Eocene animal that was somewhat hippo-like. Other modern animals with the same lineage include the African Hyrax and the elephant.

Other Sirena include the Dugong that lives near New Guinea and Australia and an Amazonian mammal that is much smaller and strictly a fresh water animal. A larger species, Steller's Sea Cow, was an arctic mammal that was exterminated by whalers in the 18th Century.

The Steller's Sea Cow was huge. Odell has the results of a dissection performed in 1742 to compare with his current observations. The 1742 work was on a 24-foot-long animal that was 20 feet around at its broadest. The heart alone weighed 36½ pounds and the stomach, stuffed with food, measured 6

by 5 feet. It took four strong whalers to move the stomach so Steller could continue with his dissection. Other findings were that the intestinal tract measured 5,968 inches, almost 20 times the length of the animal. Insulating fat layers ranged from four to nine inches deep and the thick hide itself provided another inch of protection.

German sailors called the sea cow, Borkentier, or animal with bark-like skin. Kamchatka locals called it kapustnik, or sea cabbage eater. But, whatever it was called, this gentle giant did not last long after people began visiting its arctic hideaway in the island chains that stretch between Russia and North America.

The animals, grazing at the mouths of inlets, were slaughtered and butchered to feed meat-hungry sailors. There was no apparent need to conserve them, there seemed to be many. But they may well have all been congregated as the manatees now cluster in warm Florida spots.

Georg Wilhelm Steller, naturalist with Vitus Bering's expedition, left a graphic description of the lack of concern of the feeding manatee. "The back and half the body are always seen out of the

water. They eat in the same manner as land animals....During the eating they move the head and neck like an ox, and after the lapse of a few minutes they lift the head out of the water and draw fresh air with a rasping and snorting sound after the manner of horses."

Although it is generally accepted that the last Steller's Sea Cow was killed in 1768, a 1977 article in Kamchatsky Komosomolets described a sighting by fishermen. Without an actual specimen, however, dead or alive, scientists still presume that the arctic branch of the Sirena family is gone.

The Dugong of Australian waters is threatened also. Comparative anatomy studies show some interesting differences between the Dugong and the manatee. Dugong teeth are fixed in number; manatee teeth are replaced throughout its life. And the Dugongs have tusks. Australian scientists report finding growth rings in both Dugong tusks and ear bones that help determine the animal's age, a technique that would certainly be useful in estimating the age of the Florida carcasses if the same is true of manatee ear bones.

Research Barriers. "We know little about manatee kidney function, water balance, and things like that," says Odell. "We need live animals to make any such functional studies." But no one can experiment with live animals of an endangered species. This same research barrier hampers much work on manatee behavior. Scientists are restricted to observing the social behavior of the few manatees in captivity-an unnatural social setting. There are two successful manatee colonies in zoo-like settings and young manatees have been born in both, a measure of the success of the setting.

One is at the Amsterdam zoo in Holland and the other at the Miami Seaquarium next door to Rosenstiel. Odell works with this nearby colony but he says, "Since they are endangered, we cannot manipulate them. We can only observe them: what they do with their

(Continued on page 104)
A bulky manatee is shown here sleeping on its back. The largest specimens measure about 15 feet and can weigh up to a ton. They are plant eaters.
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MAGAZINE: SCIENCE AND MECHANICS
DATE: NOVEMBER/DECEMBER 1983

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Daniel K.
es. His
rvation.
When the carcass of a dead manatee washes up on shore, above right, it Is examined, measured and scrutinized to determine the possible cause of death. Researchers are not allowed to

work on live specimens because they are endangered. The manatee is a mammal of the order Sirenia and a distant relative of the elephant. At right, a cow is nursing its calf.
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keleton
Is put aside for shipment to the Smithsonian Institution, but many other bones remain stored on shelves. Odell says there is as much to be learned from his manatee "library" as there is from more conventional, book-lined shelves. Scientists don't yet know enough to plan responsible conservation of the remaining animals. Among the large gaps in the scientific knowledge of the basic biology of this endangered species are gestation time, calving rates, longevity, migration pattems, age at sexual maturity, and social structure within herds. These aspects, like many others of interest to Odell, emphasize conservation. Odell hopes that vigorous scientific studies will provide management guidelines to help prevent the extinction of the manatee.

These gentle sea cows migrate with the water temperature. In summer they may range as far away as Texas and southern Virginia. In winter, however, they retreat to warm waters. This is when they congregate in natural warm springs or the effluent canals of power plants in Florida. Florida Power and Light (FPL) has created seasonal sanctuaries around their coastal plants, and, in their turn, the manatees did a favor for the power company.

FPL's plant near Ft. Myers on the Gulf coast was dumping large amounts of warm water into the Orange River. The Environmental Protection Agency issued a directive to stop this discharge, but FPL argued that they were supplying "a constituent element of the critical habitat that was frequented by a significant percentage of the nation's manatees." The manatees and the power company have had a synergistic relationship ever since. Most recently, FPL published a booklet featuring detailed maps of manatee sanctuaries. The Boater's Guide to Manatees, free from FPL district offices, is used both by boating citizens and by scientists trying to observe manatees in their natural habitat. The FPL sanctuaries have offered a tentative answer to one major management question: how many manatees are there left? The current Florida population is estimated at about 1,000.

Where the sea cows live when they are not all gathered in warm winter waters is less well known. Since they need large amounts of sea grass, they usually graze in shallow waters where such grasses grow. However, Odell says, "We have had rumors of manatees at 100 feet." It is known that the animals can stay submerged for 15 or 20 minutes if they are resting, though the air-breathing mammals usually dive for shorter times.

One of the important parts of the current research effort is documenting where and why manatees die. Some causes are obvious. Manatees who have become caught when a flood control dam automatically closes are found

downstream, suffocated. Barges which crush manatees on the floor of the oceans leave the mangled animal behind to wash ashore. Commercial hoop nets sometimes drown animals that become entangled. And sometimes manatees die in unexpectedly cold water. Several recent unusually cold Florida winters caused more than the usual

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■ AN S&M SPECIAL

SAVING THE MANATEE

Scientists are coming to the rescue of this gentle giant, abused nearly to the point of extinction/BY JOANN TEMPLE DENNETT!

A

Ancient mariners once mistook them for mermaids. In reality, they are aquatic relatives of the elephant and they used to thrive in the coastal waters of Florida and the Caribbean. Now their population has dwindled to the point where they are considered an endangered species. They are manatees, and they are the special interest of Daniel K. Odell, a scientist at the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences.

Civilization has not been kind to these gentle, slow moving behemoths. American Indians and early coastal settlers killed them for their tasty, beef-like flesh and their extraordinarily hard and useful bones.

That was during the last few centuries. Now, the few manatees that remain inhabit the same shallow waters as motorboating enthusiasts, and the one-ton giants are often cut down by speeding boaters. A collision that seems little more than a bump to a boater can spell death to a manatee. Deep cuts slashed in the animal's flesh by the boat's props will infect and slowly kill the harmless, grass-eating mammal. Fortunately, Odell, other scientists and, of all things,

a power and light company are making efforts to protect the manatee and preserve its natural habitat.

Endangered Giants. The Florida variety of sea cow, known as the West Indian manatee, is a marine mammal with a brownish-grey hide like an elephant, paddle-shaped flippers with fingernails, and a broad, flat tail. Bristly hair protrudes from its lips and the upper lip is split below watertight nostrils. Even though manatees can measure up to 15 feet and weigh more than a ton, they move effortlessly and gracefully in the water. But they face a multitude of dan-

Louanna C. Holden

gers in fast-growing Florida. They swim into almost any waterway having an outlet to the Gulf or the Ocean. They need

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One of the scientists involved in the preservation of manatee habitat is Daniel K. Odell of the University of Miami, shown below in his "library" of manatee bones. His studies will, he hopes, lead to conservation.

only five feet of water and, in such shallow areas, they easily get into trouble with boats, barges, fish nets, and crab pot lines and are often killed in such encounters. Some have even been trapped in automatic flood control dams.

The species Trichechus manatus is protected by both federal and state legislation. Because of this endangered status, Odell and his Rosenstiel colleagues can neither kill nor experiment with any live animals, so their only data source is the carcasses that are often washed ashore or found floating in one of Florida's many inland canals after a manatee loses in an encounter with civilization. After examining the dead animal,

measuring it and learning what he can about how it died, Odell sets parts of the carcass out in barrels with a lot of hungry maggots which eventually leave a skeleton for study.
Odell collects his manatee bones in his lab on Key Biscayne off the shore of downtown Miami. In his bone room, Odell saves at least the skull of every carcass. Sometimes the entire skeleton
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FOR
SAVING THE MANATEE
(Continued from page 82)
time, how the mother and calf interact, how much the calf suckles."

Having answers to these questions from observations of captive animals, scientists can then extend their observations into the field. In captivity, animals may be as much as ten years old before reproducing and then they may do so only once every five years. Is this the same age and rate as would occur naturally? If so, it may explain part of the reason why there are so few manatees.

Playfulness and communication between animals can be observed both in zoos and in natural settings. Manatees nuzzle one another, play follow the leader, and have often been seen body-surfing in the flumes downstream from opened dams.

An open dam provided one of the rare instances of extended "conversation" observed between animals. Odel relates the field observation of a moth and her calf. They were swimming in canal with a dam and the gates had opened far enough to allow the calf, but not its mother, to pass downstream. The current was not strong enough to pin the adult against the gates, but it did keep the calf from returning upstream.

A steady exchange of vocalizations took place between mother and calf. This continued for about three hours until the gate opened further and allowed the female to join her calf downstream.

Such communication and social play, like body-surfing, are regarded as marks of intelligence-an aspect of the manatee that is totally unexplored. And, until Odell and others like him learn enough about the manatee to assure its con-

tinued survival, intelligence may remain
an unexplored aspect of this placid
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Mark Duncan/Dayton Daily News
Sure, he's scared.
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The first dip is frightening. Even when
Dad is there. Swimming is good exer-
cise for children with asthma. It helps
build confidence, too. So they can
learn other sports.
Contact your local American Lung
Association for more information.
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Rebuth of the legendary "200 MPG" Carburetor? Possibly. Pogue got reported MPG with light car, small engine, "clean" fuel of 1930s. Famed inventor's grand-nephew. Floyd Stafford, just installed Covey vaporizer in 71 Pontiac (big V8), reports 71 MPG, 1600 mile trip!
VAPORIZES FUEL BEFORE CARB INDUCTION
New easy10-build device is incredibly simple, amazing-by efficient Fils under hood. Only 12" to 18" long, 2½" to in dam Engine cid governs size. It's heated by exhaust gases precisely-controlled for 100% fuel vapo Mabon Gasoline enters tubular spiral, instantly vapo-nizes travels to small surge tank for full-power under load enters propane-type regulator that meters vapor on engine demand, into present-carb adaptor. Low cost dual system runs on high as 100 to 1 air/fuel ratiol
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DARKROOM
(Continued from page 72)
the correct height. Allow 1/16-inch in height for foam weatherstripping that will pad the supports. Drill and counter-sink the platform for attaching the sup-ports. Fill and sand any holidays in the exposed edge plys. Cut and relieve the back of the platform as needed to clear existing mirrors. Assemble the platform to its supports with white glue and brass screws. Smooth all edges with fine sandpaper.
Plumbing. Hook up the faucet with flexible plastic supply lines. The existing lavatory lines can be tapped for this but for my installation, the rear of the wall

was accessable and rigid copper lines were used with individual hot and cold shut-off valves through the lower part of the rear wall as shown in the photos. The faucet is slipped into the slots in the faucet shelf and held by finger-tightening the nuts. These may be wrench-tightened, but this is not necessary and will make demounting more difficult. Bore a hole 1½ inches in diameter in the center of the sink, 12 inches from the left end.

The sink and platform assemblies are now removed as are the sink support cleats. Do final sanding, smoothing all edges. Vacuum and tack to remove dust. Stain all the wood. Apply three or four brushed coats of polyurethane varnish to all surfaces. Reinstall cleats, this time using all the screws. Put the sink in place, slide the faucet onto the shelf, hand-tightening the hold-down nuts. Stick self-adhesive foam weatherstripping to the bottom of the enlarger platform supports and put the platform in place on top of the lavatory. The sink drain is an ordinary 14-inch lavatory tailpiece. It is dropped through the hole in the sink bottom, sealed by a bead of clear silicon. The usual tailpiece is perforated below the flange for the expected lavatory overflow drain; our sink doesn't have an overflow, so this must be sealed to prevent leakage. Use a 1½-inch CVPC plastic coupling, sealed on its top by clear silicone against the bottom of the masonite. A rubber washer, supplied with the tailpiece, will seal the bottom of the coupling. The tailpiece threads are given three wraps of teflon tape where the tailpiece nut will seat, and the nut is tightened. The drain is completed by attaching a length of corrugated plastic sump pump drain hose to the tailpiece with a worm-gear clamp. The free end of the corrugated hose is dropped into the toilet.

A ground-fault protected duplex outlet in our half-bath was used to power an enlarger timer. A safe light is plugged into the timer and is automatically switched on when the enlarger is off.

Light-Proofing. Final work on the darkroom is completed by light-proofing. This is accomplished with foam weatherstripping on the top and sides of the door jamb, a weatherstrip sweep on the bottom of the door, and by taping the outside of the existing duplex outlet with duct tape.

You are now a heart-beat away from use and enjoyment. Keep chemicals and paper under the lavatory. Slide in a 30-inch barstool for comfort in prolonged sessions. Hang a "KEEP OUT" sign on the door. When the session is over, demount as follows: remove the enlarger and put it back in the closet; lift the enlarger platform off the lavatory and stand it on end; remove the trays and stack them under the lavatory, loosen the faucet hold-down nuts, drain the spout into the toilet, and lay the faucet behind the toilet; remove the sink and stand it on end or tilt it up on the support cleats.

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